Neuroesthetic: Brain and Art

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ABSTRACT

Neuroesthetics is a field of science that examines the beauty and art of individuals in their brains. It is a branch of science called empirical aesthetics. The formal definition was made in 2002 and its scientific foundations are based on neuroscience. Investigates the transmission and processing of five senses to the brain. For the last 20 years, the subject of art and perception of art is also the subject of aesthetic research, for which, the radiodiagnostic methods and other known techniques are used. The relationship between the structure and functional anatomy in the brain is examined. Scientific evidence suggests that art is an objective field. Developments in the neuroesthetic science increase our knowledge of the visual perception of artworks and other qualifications. New information on senses will allow us to understand perceptual aesthetic experiences.

Key Words: Art, Aesthetics, Beauty, Neurology

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Neuroesthetics is a scientific field about how people operate mentally beauty (Chatterjee, 2014). It can be defined as critical and constructive thinking about the effect of the brain on the cultural environment (Neidich, 2018). Neuroesthetic is a sub-branch of empirical aesthetics and is an artistic approach to art and music (Marin, 2015). The neuroesthetic formal definition was obtained in 2002 and its. scientific foundations is based on neural fields (Nalbantian, 2008). That is, it deals with the transmission and processing of senses and perceptions through the five senses to the brain, which are also related to past and present experiences. The response we give to different stimuli defines the art. Colors, shapes and perceived movement interact with our mind and provide a sense of feeling about it (Kephart, 2018).

For the last 20 years, neuroesthetics examines whether the art has been subject to certain rules or where the feeling comes from or whether something is art. This study field of aesthetics combines with other different fields and methods such as functional magnetic imaging, psychology, and evolutionary biology, to examine the relationship between the functional anatomy of the brain and human art perception within the framework of human development (Kephart, 2018). In other words, art is an issue that we enjoy and to a certain extent is subjective. However, it is understood that art is not as subjective as we think of scientific proof of neuroesthetics. Neuroesthetics examines the intersections of neuroscience and aesthetics (Kephart, 2018).

The light entering our eyes is separated and processed in different visual centers in our brain, which is perceived in different qualities such as light, color, and movement (Chatterjee, 2014; Chatterjee and Vartanian, 2016). It is argued that visual aesthetics, that is, the assessment of certain objects, colors or movements in specific beauty criteria is a characteristic belonging to human being (Cela et al., 2004; Leder, 2013)

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The brain has a direct effect on how we perceive and create art. It examines the extent to which different parts of the brain are active or watching art. Another interesting area is the extent to which thoughts play a role in the artistic act (Kephart, 2018). Different models have been suggested to explain the appreciation of art by people. *The physiological psychological model explains this by the arousal of the person in front of the art work. Psychologists dealing with aesthetics have tried to explain these mechanisms through psychoanalysis, gestalt or behavioral theories (Xue 2018).* There have also been different views among the schools, which consider the aesthetic perception philosophically. One approach undermines the importance of rationalization and considers art works like a natural phenomena; the other one believes that images exist in the mind and are attributed to the images during visualization. Therefore objects might be differently perceived by different individuals (Song, 2018). The aesthetic experience, however, depends on the interaction between the optional downward orientation and the creation of a visual perception that operates from the bottom up. When novice viewers automatically refer to the object definition process that operates from bottom to top, there must be a process for reducing this behavior from top to bottom so that an aesthetic perception can occur. This shows that the artists have different levels of brain activity (Cupchik et al., 2009).

The stimulation of the visual system is perceived in a contralateral way and the image is processed in both halves by the visual cortex. If the image perceived from each cortex half differently, this discrepancy is detected in the brain which causes different sensations at the level of consciousness (Zhu, 2018). In addition, artists perceive the mental representation of an object not as an original but as a depiction. Their transfers may not necessarily look like a real one. Our brains may ignore the actual light, shade and color characteristics found in nature. Therefore, artistic images that do not conform to the original are not seen by our eyes (Chatterjee, 2014). The aesthetic orientation in the individual causes more interaction in the prefrontal brain regions. This shows that this orientation is subject to cognitive control. The pragmatic orientation involves more perceptual processes and occurs in the occipital regions of the brain (Marcos and Martin, 2015).

The brain is actually like a processor. It handles all the sensory data gathered in it with its past experiences. The various regions in the brain (prefrontal cortex, orbitofrontal cortex (OFC), frontal lobe, bilateral occipital gyrus, prefrontal dorsolateral cortex (PFC) and other regions process the information in a proper manner and affect our perception and sense of an art piece. The prefrontal cortex, which allows us to detect colored objects, is particularly responsible for these functions, which will have an impact on the perception of the aesthetic stimuli that are constantly coming, because the processes related to memory and color perception are intersected in this region, and our decisions on art determine the combination of memory and visual impact (Kephart, 2018). It is known that PFC is related to the perception of color objects, decision making, and memory, and the aesthetic experience of conscious aesthetics happens during the aesthetic tasks related to the visual stimulus. Visio-spatial memory is needed to make decisions about this issue. It is well known, that OFC is important in the perception of beauty, in the case of a very beautiful image this region is activated, but there is no activity in any region in an ugly image. The medial part of the OFC responds to the text and especially to the subtitles. It is believed that OFC is related to all the stimuli (taste, odor and visual) that are actually coming (Kawabata and Zeki, 2004; Kirk et al., 2009). An aesthetically perceived work of art creates a meaningful activity in OFC. If a definition is made in the context of art, activation takes place in this region. This activity can be associated with the reward system of the brain. This system responds to both visual and semantic stimuli (Kephart, 2018) (Fig. 1).

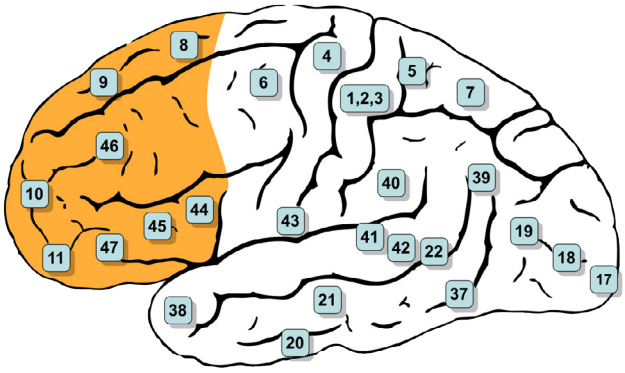

Figure 1. Prefrontal Cortex

While the PDC activates only when the beautiful stimulus arrives, the prefrontal region does not distinguish between pleasant and seedy stimuli. Prefrontal cortex guides the cognitive and perceptual mechanisms of aesthetic perception towards individuals who are novices. In fact, it is about the

top-down process and aesthetic perception. The lateral prefrontal cortex is the area related to high-level internal computing. The right lateral PFC (area 10 of Brodmann) leads to the implementation of internally prepared targets (Cela et al., 2004; Cupchik et al., 2009).

Aesthetic perception occurs in the vision centers of the brain (V1 cortex). However, signals from V1 spread to different areas in the brain. There is a network spreading rather than a single center. Therefore, the visual brain consists of many parallel processing systems and each system have a specific task (Cela et al., 2004; *Kawabata and* Zeki, *2004; Zeki, 2001)*. The centers in the brain system in the aesthetic perception of fine arts and the human body are shown in Fig. 2.

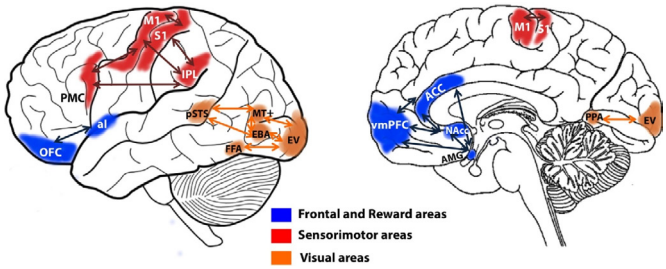

Figure 2. Centers for brain system and aesthetic perception (17)

(Diagram of neural circuits involved in aesthetic reasoning. Blue: brain regions associated with reward procedures, OFC = orbitofrontal cortices, vmPFC = ventromedian prefrontal cortex, ACC = anterior cingulate, AMG = amygdala; aI = anterior insula, and NAcc = nucleus accubens; in red, sensorimotor areas, M1 = primary motor area, S1 = primary somatosensory area, IPL = inferior parietal lobule, PMC = premotor cortex; (orange, visual areas, part of the occipitotemporal cortex: EBA = extrastriate body area, MT = motion integration area, PPA = parahippocampal place area, and pSTS). Retrieved from www.sciencedirect.com/science/article/pii/S0149763415301007.)

Art types have effects in different parts of the brain. For example, representational art of concrete objects causes increased activity in the posterior part of the brain (occipital gyrus). This region is also about memory, and attention. An abstract image has a different effect on the brain. Bilateral fusiform gyrus and left cingulate sulcus cause increased motion (Kephart, 2018).

Visual brain not only considers light, color, and movement but also distinguishes high-level objects such as faces, body or landscape. Portraits activate the area of the face in the fusiform gyrus, while the landscape activates the space in the parahippocampal gyrus. These sensory fields are also used to evaluate objects as they classify (Bao et al., 2017; Demarin et al., 2016).

When the viewers examine the images in which the movement is depicted, some of the motor systems are activated. This response is linked to the elongated mirror neuron system. The mirror neuron system plays a role in the movement and its detection. The pleasure from beauty is related to the reward center of the brain. Attractive looking faces are related to the face processing center of the brain and the ventral striatum activates the ventromedial prefrontal cortex, insula, and OFC. Insulin is associated with the autonomic nervous system, while others play a role in pleasure. Even the music, visual arts, and architectural spaces stimulate the OFC (Chatterjee, 2014). While sad images activate the right amygdala (Osaka et al., 2012), the images that affect deeply activate the prefrontal cortex (Vessel et al., 2012). The experiences and knowledge of individuals also give clues about how they perceive the works of art. Abstract artifacts are more attractive when viewed in the museum. This effect causes activation in the medial orbitofrontal and ventromedial prefrontal cortex (*Kirk et al., 2009)*. The entorhinal cortex, which is important for episodic memory, is also affected (Chatterjee, 2014; Lacey et al., 2011).

Emotions also play a role in the aesthetic process. After examining the artifacts in the insula on both sites. High activation is observed (Cupchik et al., 2009; *Bao et al., 2017)*. Activation of the bilateral occipital gyrus is due to the excessive processing requirements of the visual system (Cupchik et al., 2009; *Bao et al., 2017)*.

Neuroesthetic tries to create clarity about the place of beauty in our world, what it is, and how it will be applied to art and science. He is eager to eliminate the blur between theory and scientific evidence (Kephart, 2018).

Averageness Hypothesis: The use of photography in recognizing the face of criminals in the 19th century has been in question. While the portraits of many criminals were examined and the average guilty face was trying to be identified, no result was obtained. The faces of the criminals were beautiful (even baby-faced!). This phenomenon has been mentioned as Mean Hypothesis 5 (Kephart, 2018).

Ramachandran's Eight Laws on Artistic Experience:

While determining the general rules of aesthetics, an approach is the monitoring of the audience. In the framework of these studies, it is thought that pleasurable emotions are due to recurrent neuronal

activities caused by horizontal and vertical lines. In addition, Ramachandran's laws are defined (Salah, 2008). Ramachandran developed a highly speculative theory of human artistic experience and its associated neuronal mechanism. Although there are other explanations about the proposed issues, they still provide a general framework for visual art, aesthetics, and design (Ramachandran and Hirstein, 1999). Some of the sub-elements of the law are given below:

- *Symmetry:* Evolutionally, our brain perceives a symmetrical, as pleasant and asymmetric one as diseased. Therefore, symmetry in art seems aesthetic to human beings. In nature, water, leaves, snowflakes, flowers often give this kind of appearance. However, asymmetric images also look good in some circumstances. Symmetry is not always a visual symmetry. The balance of objects, colors or light, or the general mood emitted by the image will also stimulate the aesthetic perception of the brain. It is in harmony with the already existing understanding of beauty in the brain about the image *(Kephart, 2018;* Ramachandran and Hirstein, 1999; Wald, 2015*)*.

- *Grouping:* Humans tend to group objects in the foreground in a mixed background. Evolutionally this is due to the tendency to group and classify camouflaged objects to protect themselves and to avoid danger. If we can distinguish an object in the complex, the brain rewards us with the release of endorphins. Successful works of art first create confusion and then a sense of awareness and pleasure. In addition, instead of showing a model completely naked, partial nudity is more provocative (*Kephart, 2018;* Ramachandran and Hirstein, 1999).

- *Isolation:* *The simple, empty or colorless part of the work causes the excitation of the limbic system. Empty or missing places are filled with the viewer's own feelings. This is especially the reason why the minimalist current is successful. The reward mechanism is that the emotions and feelings associated with the work, in contrast to their complex abstract or concrete works, make the viewer feel the emotion in their emotions. Sharp angles and edges help us to maintain our contact with the image because we can hardly detect color and light gradients* (*Kephart, 2018;* Ramachandran and Hirstein, 1999)*.*

- *Contrast:* *It can be expressed as being unnecessary and focusing on the main object. The cells in the retina, the lateral geniculate body, and the visual cortex are sensitive to the change of light rather than homogeneous surface colors. The visual system identifies segmental segmentation of shadows more easily than soft gradients. Edge-forming contrasts are more pleasing to the eye. This also has evolutionary foundations. Areas with contrast contain more information and require attention. Unlike the grouping feature, the characteristics of the contrast are close to the distance and reveal the need to associate non-distant but similar features* (*Kephart, 2018;* Ramachandran and Hirstein, 1999; David and Torsten, 2005)*.*

- ***Peak Shift Principle:*** Our brain shows more interest in exaggerated images. Image of an object, size, shape, color, etc. If shown with exaggerated qualities, our brain will react more. In the photograph, such effects are obtained by lens effects or by light applications by reducing or increasing the exposure of certain regions (Chatterjee, 2014; *Kephart, 2018;* Ramachandran and Hirstein, 1999; Maynard, 2016).

- ***Overview:*** The visual system is based on a single viewpoint. On the contrary, a team that allows an infinite number of viewing angles accepts the retinal image. When interpreting two overlapping objects in a landscape photo, he accepts that the foreground has closed the back. On the contrary, he does not accept that a part of the back object is lost. If an artist wishes to leave the eye satisfied, they should avoid such overlaps. However, this may not always be a valid rule. Occasionally, overlaps can satisfy the viewer (*Kephart, 2018;* Ramachandran and Hirstein, 1999).

- *Perceptual Problem Solving:* It is expressed that it is more enjoyable to discover the object after an occupation in relation to grouping and contrast laws. This activity is motivating and continues until the object is found. This is part of the urge to self-preservation from an evolutionary point of view and the pursuit of a constant aggressor (*Kephart, 2018;* Ramachandran and Hirstein, 1999).

- Visual Metaphors: Metaphors appear as unrelated to each other on the surface, but work as a mental tunnel between two concepts with deep connections. It is possible that finding similarities between two objects will depend on effective communication or cognitive reasons. The presence of similarities causes activation in the limbic system and generates a reward mechanism (*Kephart, 2018;* Ramachandran and Hirstein, 1999).

Semir Zeki's Visual Brain Law: To try to understand science from art is to believe that art

will make understandings of what is happening in our brain. Art is a product of brain variability. The neurological approach is likely to explain subjective experiences, art creation, or variability in experience (*Zeki, 2001)*.

The Two Theories Have Been Argued:

Constancy: Based on our external experience, our brain can recognize and understand objects in the art (*Kephart, 2018;* Ramachandran and Hirstein, 1999). Although visual stimuli have been altered (distance, perspective, enlightenment, etc.), the brain is capable of storing information about the basic properties of an object and eliminating invalid dynamic properties. The essence of a work of art is preserved while creating a work of art. When a work is created, it can take a different form than the eye sees, it gets the state that the artist perceives and feels. This is tried to be explained by the concept of Platonic Ideal and Hegel (Zeki, 1998).

- ***Abstraction:*** The inadequacy of our memory has allowed us to do abstraction (*Kephart, 2018;* Ramachandran, 1999). Art in some way allows the abstraction of the brain to be expressed (Chatterjee, 2014; *Zeki, 2001)*.

In neurosurgical studies, radiodiagnostic methods, as well as transcranial magnetic measurements or direct electrical currents, are used. It is possible to stimulate brain regions with these methods. For example, stimulation of the left dorsolateral prefrontal cortex increases the interest in concrete works of art more than abstract artifacts. The use of these studies in other fields such as sensory-motor circuits, emotion processing and the emergence of meaning are promising (Chatterjee, 2014).

The effects of art and photography on the brain are often unconscious. It is possible to reveal the reward mechanisms in the brain with works of art. Thus, we observe works of art with good feelings. The research of the science of neuroesthetics shows us how these processes work. In other words, science meets with art (*Kephart, 2018;* Ramachandran and Hirstein, 1999).

However, works of art mediate ideas embedded in a specific context. The meanings of the works can be completely fluid and open to different interpretations depending on the individual, culture and time. Reactions to the work depend on the ideas that individuals defend. The artist's intention, the cultural and historical context in which the work is subjected, increases the viewer's respect for the work. However, neuroscience is not yet able to solve this complexity (Chatterjee, 2014). In parallel with the scientific developments in the field of neuroesthetics, studies on the visual perception of artworks and other qualities are continuing. Obtaining information about visual and other senses will enable us to better understand perceptual aesthetic experiences (Cinzia and Vittorio, 2009) and widen our knowledge in neuroaesthetics.

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